



Shenzhen Belling Efficiency Testing Lab



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Test report of

IES LM-79-08

**Approved Method: Electrical and Photometric
Measurements of Solid-State Lighting Products**

Applicant:

P.Q.L., Inc.

Address:

2285 Ward Avenue / Simi Valley, CA 93065

For Product:

Direct Linear Ambient Luminaires

Model No.:

91099(3000K) / 91101, 9110X(5000K)

Test laboratory: Shenzhen Belling Efficiency Testing Lab., 1/F., Building 1, 1F, No.1 building, Meibaohe industrial park, Dalang street, Shenzhen, Guangdong Prov.518101, China.

Cherie Tang

Jason Zhou

Complied by: Cherie Tang

Review by: Jason Zhou

Project Engineer

Technical Manager

Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Shenzhen Belling Efficiency Testing Lab. This report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.



1 General

1.1 Product Information

Manufacturer	P.Q.L., Inc.
Manufacturer Address	2285 Ward Avenue / Simi Valley, CA 93065
Brand Name	Superior Life®
Luminaire Type	Direct Linear Ambient Luminaires
Model Number	91099(3000K) / 91101, 9110X(5000K)
Rated Inputs	AC 100-277V 50/60Hz
Rated Power	14W
Nominal CCT	3000K / 5000K
Date of Receipt Samples	2017-04-06

1.2 Standards or methods

- ANSI C78.377-2015: Specifications for the Chromaticity of Solid State Lighting Products
- ANSI C82.77-2002: Harmonic Emission Limits-Related Power Quality Requirements for Lighting Equipment
- CIE Publication No.13.3-1995: Method of Measuring and Specifying Color Rendering of Light Sources
- IESNA LM-79-08 Approved Method: Electric & Photometric Measurement of Solid-state Lighting Products



1.3 Equipment list

Device	Manufacture	Model No.	Serial No.	Calibration due date
Goniophotometric System	SENSING	GMS-3000	N.A	2017-09-21
AC Power Source	ALL POWER	APW-110N	992257	2017-08-27
Total Luminous Flux Standard Lamp	SENSING	110V/100W	S13100234	2017-09-15
Digital Power Meter	YOKOGAWA	WT310	C2QM02030V	2017-08-29
Integral Sphere	SENSING	SPR-600M	N.A	2017-08-27
Digital Power Meter	YOKOGAWA	WT210	91L929742	2017-08-29
Optical Color and Electrical Measurement System	SENSING	SPR-3000	N.A	2017-08-27
Temperature/humidity/clock	VICTOR	VC230	57636	2017-09-13
Digital Anemometer	TECMAN	TD8901	026141	2017-09-13

Statement of Traceability: Shenzhen Belling Efficiency Testing Lab attests that all calibration has been performed using suitable standards traceable to national primary standards and International System of Unit (SI).



2 Test conducted and method

2.1 Ambient Condition

The ambient temperature in which measurements are being taken was maintained at $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$, the air flow around the sample(s) being tested did not affect the performance.

2.2 Power Supply Characteristics

The AC power supply had a sinusoidal voltage wave shape at the prescribed frequency (60 Hz) such that the RMS summation of the harmonic components does not exceed 3 percent of the fundamental during operation of the test item.

The voltage of AC power supply (RMS voltage) applied to the device under test was regulated to within ± 0.2 percent under load.

2.3 Seasoning and Stabilization

No seasoning was performed in accordance with IESNA LM-79-08. And before the measurement, the sample was stabilized until the light output and power variations were less than 0.5% in 30 minutes intervals (3 readings, 15 minutes apart).

2.4 Integrating Sphere System

The system includes AC power source, digital power meter, DC power supply, spectrophotometer, and integrating sphere. The integrating sphere system is calibrated by standard light source before measurement. The system and standard light source has been calibrated regularly and traceable to the National Primary Standards. 4π geometry was used during measurement. The product was operated in its intended orientation in application and was recorded in this report.

2.5 Goniophotometer System

The goniophotometer system is calibrated by standard light source before measurement. The standard light source has been calibrated regularly and traceable to the National Primary Standards.

Type C goniophotometer was used for measuring total luminous flux, luminous intensity distribution, and color spatial uniformity. The product was operated in its intended orientation in application and was recorded in this report. The method according to IESNA LM-79-08 following chapter.



3 Test Result Summary

3.1 Integrating Sphere System

3.1.1 Electrical data

Model Number	Input Voltage(V)	Frequency (Hz)	Input Current (A)	Power (W)	Power Factor
91099(3000K)	120.07	60	0.121	14.2	0.977
91101, 9110X(5000K)	120.08	60	0.122	14.3	0.976

3.1.2 Additional Test

Test Item	Model	Test Voltage (V)	Frequency (Hz)	Test Result
Power factor	91099(3000K)	120	60	0.977
		277	60	0.915
	91101, 9110X(5000K)	120	60	0.976
		277	60	0.920
Total harmonic distortion	91099(3000K)	120	60	10.8%
		277	60	15.9%
	91101, 9110X(5000K)	120	60	11.4%
		277	60	16.7%
Off state power (W)	91099(3000K)	120	60	0
	91101, 9110X(5000K)	277	60	0

3.1.3 Photometric data

Model Number	Luminous Flux (lm)	Efficacy (lm/W)	CCT (K)	CRI	R9
91099(3000K)	1576.561	111.025	2875	82.9	9
91101, 9110X(5000K)	1651.764	115.508	4960	82.3	8

3.1.4 Chromaticity Coordinate

Model Number	Duv	x	y	u'	v'
91099(3000K)	-0.0021	0.4428	0.4007	0.2559	0.5209
91101, 9110X(5000K)	0.0056	0.3475	0.3649	0.2080	0.4914



3.2 Goniophotometer System

3.2.1 Electrical data

Model Number	Input Voltage(V)	Frequency (Hz)	Input Current (A)	Power (W)	Power Factor
91099(3000K)	120.03	60	0.1214	14.1280	0.9692

3.2.2 Photometric data

Luminous Flux (lm)	Efficacy (lm/W)	Zonal Lumen in 0-60°(%lm)
1557.05	110.21	60.650



4 Test Data

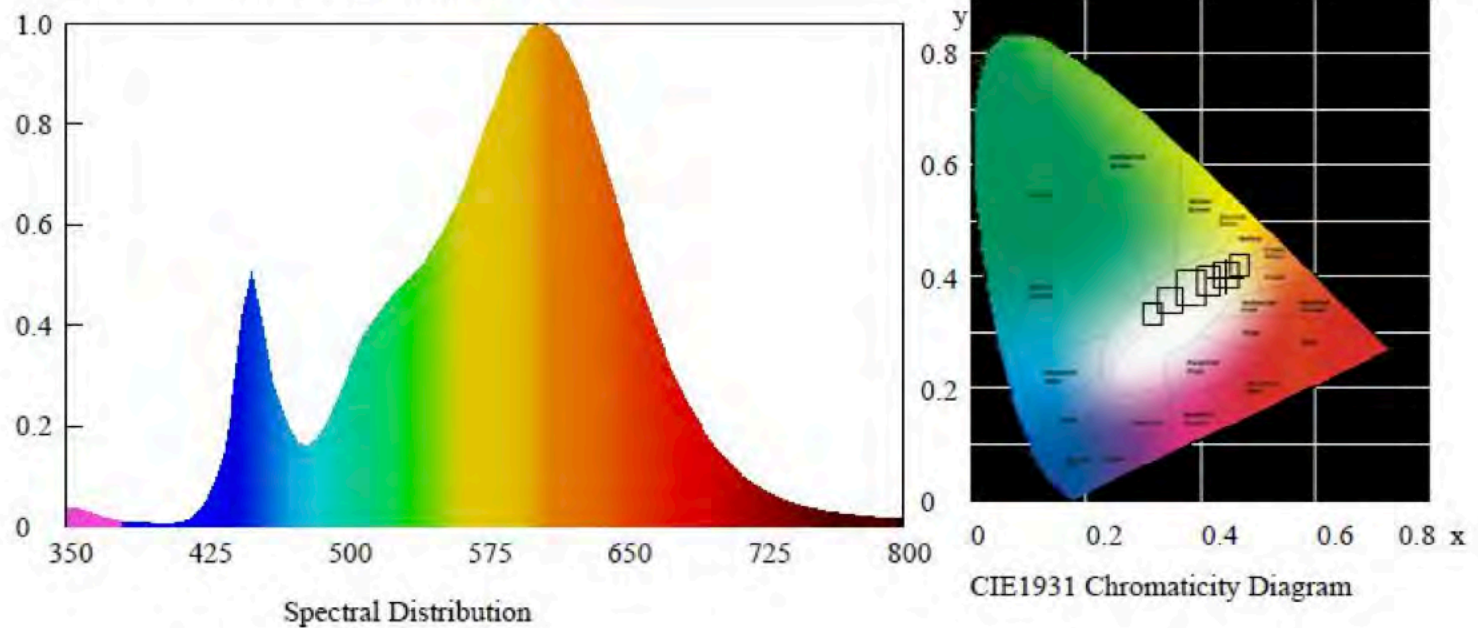
91099(3000K)

Test Condition

Temperature: 25°C
Spectrum Range: 350-800 nm

RH: 58%
Scan Step: 5 nm

Spectroradiometric Parameters



Chromaticity Coordinates: $x=0.4428$ $y=0.4007$ $u'=0.2559$ $v'=0.5209$

Correlated Color Temperature: 2875 K

Dominant Wavelength: 583.0 nm(E)

Luminous Flux: 1576.561 lm

Purity: 0.5324

Chromaticity Difference: -0.0021Duv

Peak Wavelength: 637.5 nm

Color Ratio: $K_r=46.3\%$ $K_g=46.7\%$ $K_b=7.0\%$

Bandwidth: 127.9nm

Radiant Flux: 4.924 W

Rendering Index: $R_a=82.9$

$R_1=82$ $R_2=92$ $R_3=96$ $R_4=81$ $R_5=82$ $R_6=90$ $R_7=82$ $R_8=59$

$R_9=9$ $R_{10}=81$ $R_{11}=81$ $R_{12}=75$ $R_{13}=85$ $R_{14}=98$ $R_{15}=74$

Electric Parameters

Voltage: 120.07 V

Current: 0.121 A

Power Factor: 0.977

Power: 14.2 W

Luminous Efficacy: 111.025 lm/W



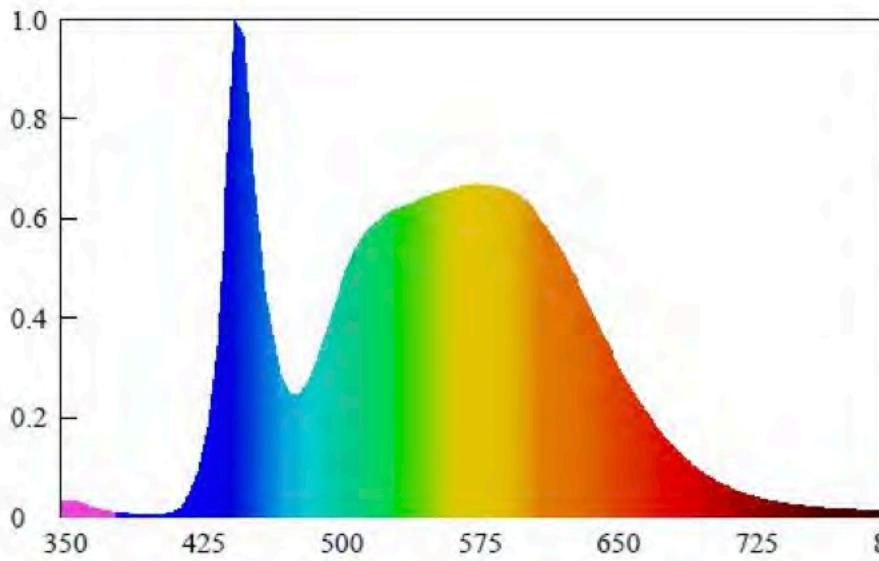
91101, 9110X(5000K)

Test Condition

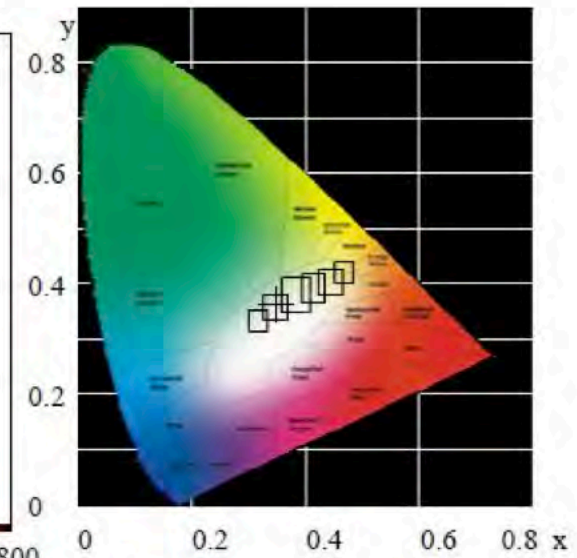
Temperature: 25°C
Spectrum Range: 350-800 nm

RH: 58%
Scan Step: 5 nm

Spectroradiometric Parameters



Spectral Distribution



CIE1931 Chromaticity Diagram

Chromaticity Coordinates: $x=0.3475$ $y=0.3649$ $u'=0.2080$ $v'=0.4914$

Correlated Color Temperature: 4960 K

Dominant Wavelength: 567.0 nm(E)

Luminous Flux: 1651.764 lm

Purity: 0.1362

Chromaticity Difference: 0.0056Duv

Peak Wavelength: 439.9 nm

Color Ratio: $K_r=33.2\%$ $K_g=55.5\%$ $K_b=11.3\%$

Bandwidth: -375.6nm

Radiant Flux: 5.161 W

Rendering Index: $R_a=82.3$

R1=80 R2=86 R3=92 R4=83 R5=80 R6=81 R7=89 R8=68

R9=8 R10=67 R11=82 R12=59 R13=82 R14=95 R15=74

Electric Parameters

Voltage: 120.08 V

Current: 0.122 A

Power Factor: 0.976

Power: 14.3 W

Luminous Efficacy: 115.508 lm/W

**Zonal Flux Diagram**

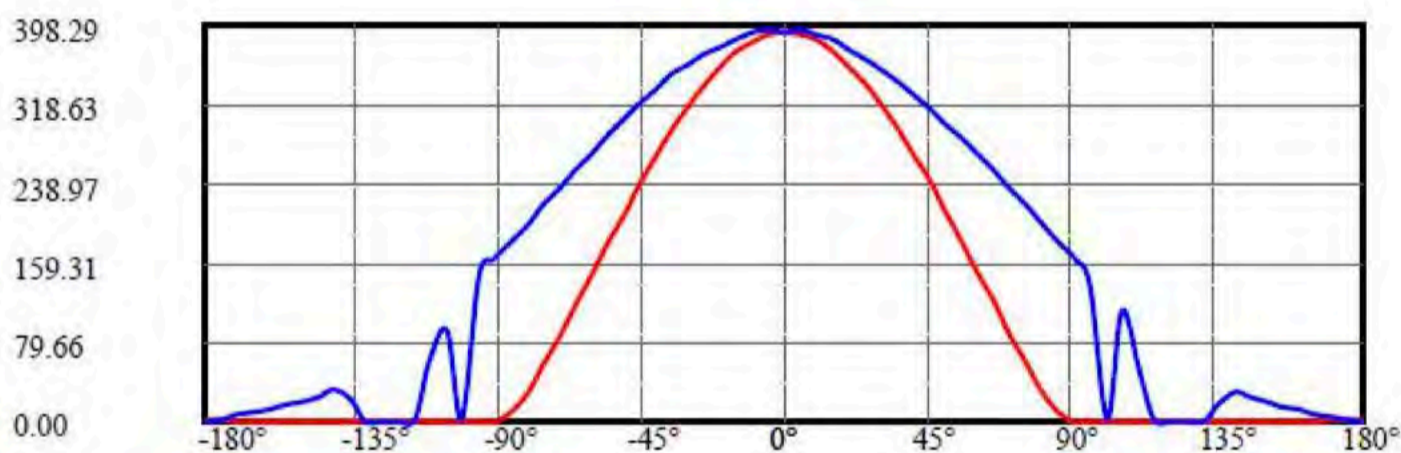
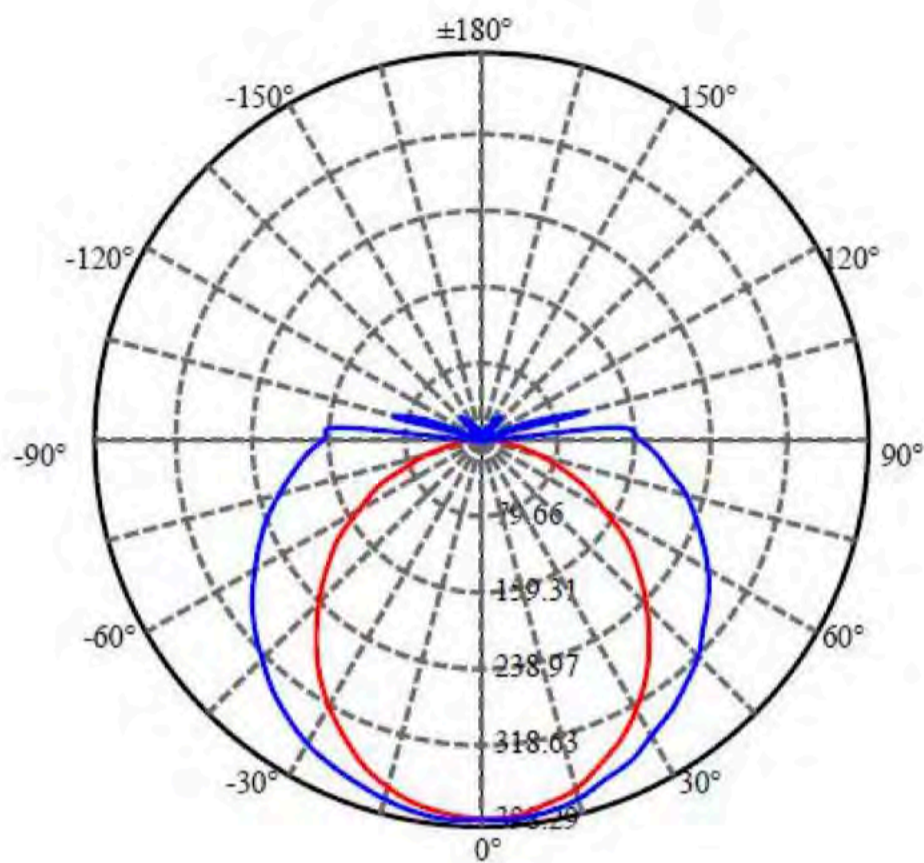
Zonal flux distribution table

$\gamma(^{\circ})$	Average I(cd)	Zonal F(lm)	Sum F(lm)	Eff Flux(%)	Eff Sum(%)
0.0	395.012	.000	.000	.000%	.000%
5.0	393.749	9.429	9.429	.606%	.606%
10.0	388.892	27.998	37.427	1.798%	2.404%
15.0	380.706	45.652	83.079	2.932%	5.336%
20.0	369.702	61.844	144.923	3.972%	9.308%
25.0	356.285	76.143	221.066	4.890%	14.198%
30.0	340.647	88.197	309.263	5.664%	19.862%
35.0	322.886	97.710	406.973	6.275%	26.137%
40.0	303.613	104.527	511.499	6.713%	32.851%
45.0	283.077	108.630	620.130	6.977%	39.827%
50.0	261.306	110.000	730.130	7.065%	46.892%
55.0	239.244	108.836	838.966	6.990%	53.882%
60.0	216.654	105.380	944.346	6.768%	60.650%
65.0	194.259	99.894	1044.239	6.416%	67.065%
70.0	171.988	92.736	1136.975	5.956%	73.021%
75.0	150.578	84.314	1221.289	5.415%	78.436%
80.0	130.264	75.146	1296.435	4.826%	83.262%
85.0	111.935	65.811	1362.246	4.227%	87.489%
90.0	96.214	56.993	1419.239	3.660%	91.149%
95.0	65.965	44.406	1463.644	2.852%	94.001%
100.0	14.167	21.774	1485.418	1.398%	95.400%
105.0	43.236	15.360	1500.778	.986%	96.386%
110.0	17.039	15.755	1516.533	1.012%	97.398%
115.0	4.759	5.520	1522.052	.354%	97.752%
120.0	4.079	2.149	1524.201	.138%	97.890%
125.0	6.591	2.466	1526.667	.158%	98.049%
130.0	9.796	3.563	1530.230	.229%	98.278%
135.0	17.289	5.473	1535.703	.351%	98.629%
140.0	16.942	6.338	1542.041	.407%	99.036%
145.0	13.987	5.160	1547.201	.331%	99.367%
150.0	11.475	3.749	1550.951	.241%	99.608%
155.0	9.172	2.613	1553.564	.168%	99.776%
160.0	7.021	1.698	1555.262	.109%	99.885%
165.0	5.203	1.007	1556.270	.065%	99.950%
170.0	3.552	.519	1556.789	.033%	99.983%
175.0	2.400	.213	1557.002	.014%	99.997%
180.0	1.471	.046	1557.048	.003%	100.000%



Luminous Intensity Distribution Diagram

Light Distribution Curve [Unit:cd]



C0/C180: ———

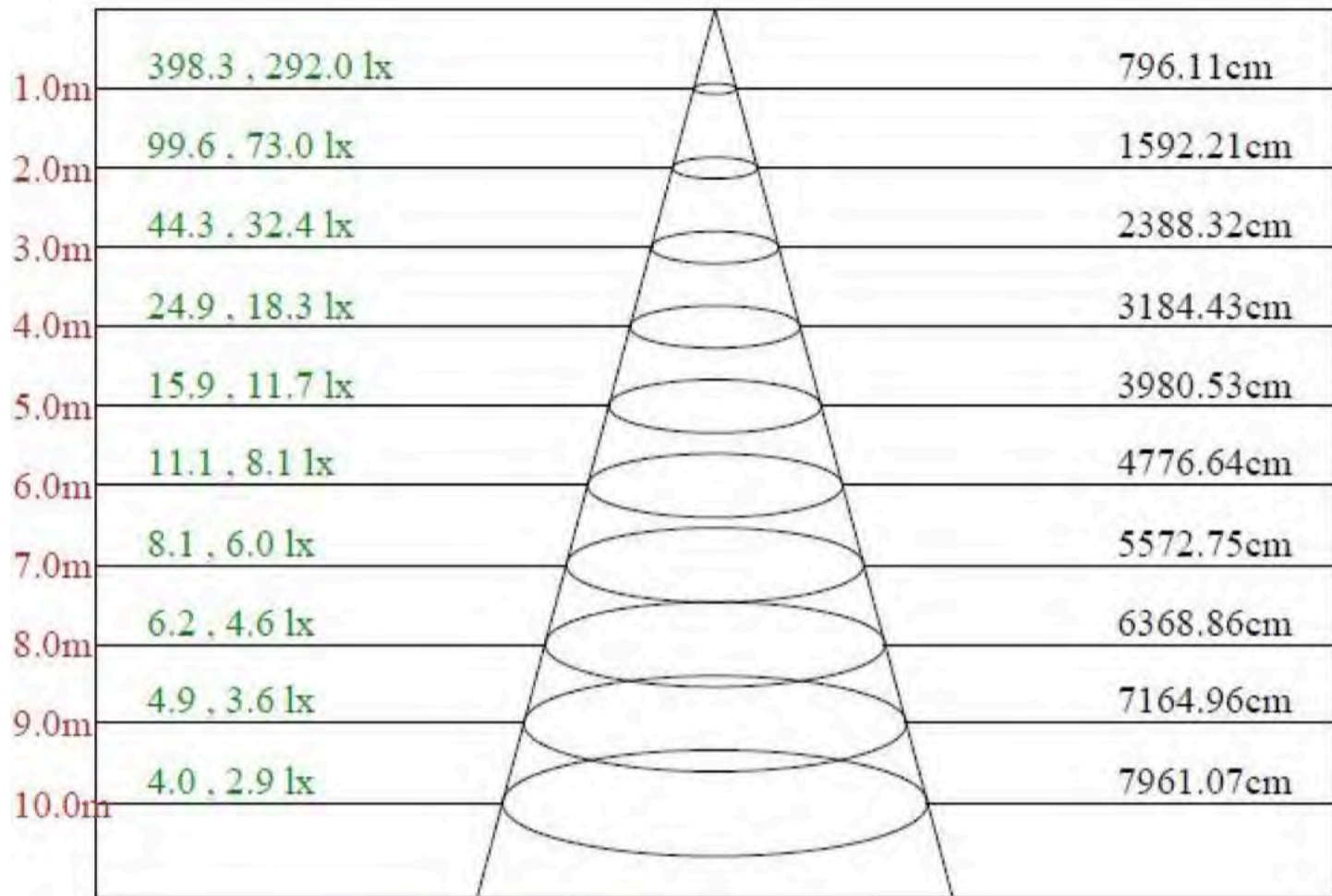
C90/C270: ———

Field angle(10%Imax):C0/180Left:78.4 Right:78.8
:C90/270Left:106.8 Right:116.2

Beam Angle(50%Imax):C0/180Left:52.2 Right:52.7
:C90/270Left:75.5 Right:85.8



Lux distance Curve



Max , Ave

Beam angle of C67.5plane151.75

**Luminous Intensity Distribution Data**

$C/\gamma(^{\circ})$	0.0	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0
0.0	390.52	388.52	382.30	371.65	356.77	339.68	318.58	295.27	268.63
22.5	395.40	393.85	388.07	377.64	364.76	348.11	327.69	305.04	281.73
45.0	396.73	395.18	390.96	383.41	373.20	360.10	345.67	329.24	310.59
67.5	398.29	397.62	394.29	388.74	381.19	371.42	359.43	345.45	331.02
90.0	390.96	392.51	389.18	382.97	373.87	364.76	352.55	341.45	328.80
112.5	398.06	396.29	392.29	386.08	377.42	366.76	354.77	339.90	324.36
135.0	396.07	393.18	387.63	378.97	367.87	353.88	337.68	319.03	300.16
157.5	394.07	390.52	383.19	372.31	356.77	338.34	317.92	295.50	271.07
180.0	390.52	388.07	381.19	369.87	355.22	336.57	315.92	291.94	265.97
202.5	395.40	393.18	386.30	375.64	360.54	342.56	322.36	300.60	276.63
225.0	396.73	394.51	389.41	381.41	370.76	357.66	342.34	324.58	304.60
247.5	398.29	397.40	393.40	386.96	378.75	368.76	357.44	343.23	328.13
270.0	390.96	392.96	389.85	383.41	376.31	368.54	359.21	347.67	335.01
292.5	398.06	397.62	394.96	389.41	381.64	372.53	361.21	347.67	333.02
315.0	396.07	395.18	390.96	383.19	373.42	359.88	344.34	327.47	309.26
337.5	394.07	393.40	388.30	379.64	366.76	351.00	333.24	312.15	288.84
360.0	390.52	388.52	382.30	371.65	356.77	339.68	318.58	295.27	268.63
$C/\gamma(^{\circ})$	45.0	50.0	55.0	60.0	65.0	70.0	75.0	80.0	85.0
0.0	241.33	211.80	181.60	150.75	120.77	90.14	59.94	32.41	10.43
22.5	257.09	230.89	204.92	178.27	152.08	127.66	104.35	83.48	65.05
45.0	291.28	270.41	248.65	226.23	205.36	183.38	163.18	143.86	125.66
67.5	314.59	297.05	278.85	260.86	241.99	223.56	204.03	185.60	166.95
90.0	315.25	299.27	285.28	270.63	253.31	234.67	218.24	199.37	181.16
112.5	308.37	291.06	273.29	255.09	237.77	220.01	202.25	183.38	165.40
135.0	279.73	258.86	238.44	216.90	195.81	174.50	155.85	137.87	120.11
157.5	245.99	220.90	194.70	168.73	142.75	118.33	95.02	74.82	58.61
180.0	238.00	208.25	178.50	147.86	117.00	87.25	57.72	30.42	9.32
202.5	251.76	225.34	199.37	172.50	146.75	121.00	97.46	76.82	59.28
225.0	283.29	261.75	239.33	217.35	196.70	176.28	155.41	136.09	119.44
247.5	311.48	293.28	274.85	256.87	238.22	218.01	199.81	181.60	163.84
270.0	320.14	303.49	287.50	269.96	251.98	234.89	216.46	198.26	180.94
292.5	317.03	299.49	281.73	263.53	243.99	224.67	204.92	186.49	167.84
315.0	289.95	269.74	248.87	227.12	206.47	185.60	165.18	145.42	127.66
337.5	263.97	239.33	212.02	183.82	157.18	131.87	109.45	88.36	69.27
360.0	241.33	211.80	181.60	150.75	120.77	90.14	59.94	32.41	10.43
$C/\gamma(^{\circ})$	90.0	95.0	100.0	105.0	110.0	115.0	120.0	125.0	130.0
0.0	0.67	0.44	0.44	0.44	0.44	0.44	0.44	0.67	0.67
22.5	49.51	14.65	5.55	3.11	4.00	11.99	10.43	9.55	8.66
45.0	108.56	58.17	37.08	32.19	4.00	2.66	2.00	10.66	23.98
67.5	150.52	127.43	7.77	90.36	30.19	2.22	1.78	1.33	2.89
90.0	163.40	136.54	1.33	110.56	51.06	1.33	1.11	1.11	1.11
112.5	148.30	95.46	7.33	89.25	20.87	2.44	2.00	1.55	4.44
135.0	104.57	16.87	62.39	17.10	3.77	2.89	2.22	15.54	24.42
157.5	45.29	19.32	4.22	2.66	6.88	12.43	11.32	10.21	9.55
180.0	0.67	0.44	0.44	0.44	0.44	0.44	0.44	0.67	0.67
202.5	45.51	16.43	5.11	3.11	9.55	12.21	11.10	10.21	9.32
225.0	103.01	43.74	48.18	25.75	4.22	3.11	2.44	18.43	24.20
247.5	145.42	128.32	8.66	89.47	28.20	3.11	2.22	2.00	5.99
270.0	162.29	145.20	1.55	91.25	60.61	1.33	1.11	1.11	1.11
292.5	148.97	134.32	8.88	89.69	40.63	2.44	1.78	1.55	3.77
315.0	109.90	93.69	14.88	42.40	4.66	3.33	2.44	9.77	25.75
337.5	52.84	24.42	12.88	4.00	3.11	13.77	12.43	11.10	10.21
360.0	0.67	0.44	0.44	0.44	0.44	0.44	0.44	0.67	0.67



C/γ(°)	135.0	140.0	145.0	150.0	155.0	160.0	165.0	170.0	175.0
0.0	0.67	0.89	0.89	0.89	1.11	1.11	1.11	1.33	1.55
22.5	8.44	7.55	6.88	5.99	5.11	4.22	3.55	2.66	2.22
45.0	20.20	16.43	13.77	11.55	9.55	7.77	5.99	4.22	2.66
67.5	27.53	25.98	20.65	16.65	13.32	10.21	7.55	5.33	2.89
90.0	17.76	29.75	23.53	18.65	14.65	11.55	8.44	5.77	3.33
112.5	28.86	26.20	20.87	16.87	13.32	10.21	6.88	3.55	2.22
135.0	20.65	16.87	13.99	11.55	8.88	5.99	4.22	2.66	2.44
157.5	8.44	7.55	6.66	5.33	4.00	3.11	2.44	2.44	2.00
180.0	0.67	0.67	0.67	0.89	0.89	0.89	1.11	1.11	1.33
202.5	8.44	7.55	6.66	5.55	4.00	2.89	2.66	2.00	1.78
225.0	20.87	17.76	14.88	12.43	9.55	6.44	4.22	2.89	2.22
247.5	32.19	27.53	22.87	18.43	14.65	11.32	7.33	4.00	2.00
270.0	21.98	31.30	25.53	20.65	16.87	12.88	9.32	6.22	3.55
292.5	28.86	28.20	23.09	19.09	15.10	11.32	8.44	5.77	3.55
315.0	22.20	18.87	15.76	12.88	10.43	8.21	6.44	4.44	2.66
337.5	8.88	7.99	7.10	6.22	5.33	4.22	3.55	2.44	2.00
360.0	0.67	0.89	0.89	0.89	1.11	1.11	1.11	1.33	1.55
C/γ(°)	180.0								
0.0	1.55								
22.5	1.55								
45.0	1.55								
67.5	1.55								
90.0	0.89								
112.5	1.55								
135.0	1.55								
157.5	1.55								
180.0	1.55								
202.5	1.55								
225.0	1.55								
247.5	1.55								
270.0	0.89								
292.5	1.55								
315.0	1.55								
337.5	1.55								
360.0	1.55								



Photo Document



****End of test report****